

- II. DEWBERRY. Stems trailing, but in the first three species occasionally erect, recurving to the ground if elongate.
- A. Leaflets oval or ovate, acute or pointed, dull, usually somewhat pubescent beneath; pedicels long and ascending; prickles stiff.
1. Branches few- to several-flowered.
- a. Leaflets large, thin, coarsely and simply toothed, terminal one usually rounded at the base; flowers and fruit large; stems stout with tall branches. *R. invisus.*
- b. Leaflets firm, sharply and somewhat doubly toothed; plant every way smaller. *R. villosus.*
2. Branches 1-flowered (sometimes 2-flowered); leaflets thin; stems slender, with few minute prickles. *R. Enslenii.*
- B. Leaflets obovate, blunt, glabrous, shining; pedicels in flower short, divergent; flowers and fruit small; stems slender, with small, weak bristles. *R. hispidus.*
- (Trailing forms of *R. setosus* may be looked for here and may be separated by the acute, dull leaves and larger flowers.)

THE RELATION OF CERTAIN PLANTS TO ATMOSPHERIC MOISTURE.

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ORCHIDS. In making some tests of absorption by orchids, in the interests of the scientific side of practical gardening, I was surprised to find little or none of the power of condensing water-vapor which is popularly ascribed to the aërial roots of epiphytes. Not the public alone, but gardeners universally, and botanists pretty generally, regard air-plants as capable of "feeding upon the air." The highest authority, too, may be cited in support of such an opinion. Thus Sachs¹ says, "The walls [of the velamen] are capable of imbibing, and are able to absorb, not only rain and dew but even the vapor of the atmosphere." Kerner,² the popularity of whose Natural History of Plants gives his opinions wide vogue, is explicit in the assertion that "the power of condensing aqueous vapor, and other gases as well, is of the greatest importance to these plants." He repeats and amplifies this at considerable length.

The doctrine of vapor-absorption goes back to the experimental work of Unger³ (1854) and Leitgeb⁴ (1864). The contrary view was expressed, after experimentation, by Duchartre⁵ (1856). He says that "the leaves do not breathe in the vapor of water diffused in

¹ Phys. of Plants, Eng. Tr., 1887, p. 25. ² Natural History of Plants, Vol. I., p. 222.

³ Physiologie der Gewächse, 1855, p. 307. ⁴ Denkschr. d. Wiener Akad., 1864, p. 215.

⁵ Quoted, Bull. de la Soc. Bot. de Fr., 1895, s. 3, t. II, p. 99.

the air, whatever the proportion; and aërial roots are equally devoid of any power of absorbing vapor." Goebel,¹ from extended observation of epiphytes in their native habitats, arrives at the conclusion that absorption of vapor is at any rate not the chief function of aërial roots, and approves Duchartre's opinion. Schimper² is equally reserved.

Up to the present moment too little experimental evidence is available to enable one to form a final opinion. It is easy to see possible defects in all the methods employed. For example, cut-off roots, it may be held, are under essentially unnatural conditions. On the other hand if one works with entire plants, transpiration from the shoot and assimilation enter as factors in the loss or gain of weight. Again, the vapor-conditions have been under no sort of control (with one exception to be mentioned). Thus when Kerner writes as follows, one is disposed to attribute the increase of weight to the formation of dew in a closed receptacle, the temperature of which was not guarded against change. He says: "If the aërial roots of *Oncidium sphacelatum* are transferred from a chamber full of dry air to one full of moist air, they take up in twenty-four hours, somewhat more than eight per cent of their weight of water." According to Pfeffer,³ Sachs probably introduced the same error into his determination of imbibition by dried wood. As to aërial roots Pfeffer is silent, as far as I have read his latest text; but he notes the very indifferent capacity of vegetable tissues in general for acquiring water in the gas-form.

When my first tests were made, with cut roots partially dried in the laboratory and then laid in a moist orchid house, I looked for an addition to the weight. The humidity there was usually from .80 to .85. I found at the end of twenty-four hours, that the roots were drier and lighter than at the beginning.

A large box was then partly filled with sphagnum. This was soaked with water, a glass was placed on the sphagnum, and on this were laid the roots. A wet and dry bulb hygrometer, read through glass let into the end of the box, gave the humidities. Finally the whole was closed in by a sheet of glass, so that the roots had the advantage of light. The ventilation was so adjusted that at no time did the humidity rise above .95, and varied from this down to a bit below .90.

¹ Pflanzenbiologische Schilderungen I, p. 188. ² Pflanzen-Geographie, 1898, p. 343.

³ Pflanzenphysiologie, last edition, p. 143.

Precipitation of dew was thus wholly precluded, and yet the roots were exposed to the action of a greater proportion of vapor than usually obtains in nature. If at the above humidity the roots were found to be unable to win a supply of water, then it would seem that their condensing power must be unimportant or wanting.

As to the evidence from cut roots, this may be said in favor of its admittance, viz., that the roots of epiphytes, as Schimper points out, play a considerable rôle in assimilation. The growing tips are intensely green, and the parenchyma under the velamen is provided with chlorophyll. In one West Indian *Angraecum*, indeed, the roots have usurped the function of leaves, so that except at the flowering season the plant body consists almost wholly of roots. From the physiological standpoint, therefore, cut roots may be considered fairly perfect wholes.

It must be granted, however, that the point is open to objection; and Dr. Goodale has proposed a method of using whole plants which seems the most satisfactory mode yet devised. Thus far the results obtained by this method accord with those obtained from cut roots.

The genera represented (by twenty-four species) were *Dendrobium*, *Epidendrum*, *Peristeria*, *Scuticaria*, *Laelia*, *Cattleya*, *Burlingtonia*, *Brassavola*, *Cymbidium*, *Brassia*, *Selenipedium*, *Vanda*, *Cypripedium*, *Oncidium*, *Angraecum*, *Masdevallia*, *Odontoglossum*, and *Maxillaria*. From many of the species several different roots were used.

The trials lasted in each case from two to four days, and in a few cases much longer. Some roots were taken from unwatered plants, and after weighing were put at once into the damp-box. Others were left in the laboratory until very dry to the touch, but put to the test while the tips were still green and turgid. The cut ends were usually waxed or otherwise sealed.

In all cases a diminution of weight was ascertained. The shriveling was often astonishing. Control roots from some of the same plants, having access to liquid water, kept vigorous and active in the same box. The manner of the drying up was significant. It began at the cut end and traveled toward the still turgid terminal portion. The latter seemed to be drawing water from the older parts. At any rate the velamen was entirely unable to supply, out of the abundant vapor at hand, the needs of the suffering cells beneath.

Since my work with cut roots was completed, the Centralblatt has

published a paper by Nabokich¹ in which he reaches the same conclusion as Duchartre. Nabokich used cut roots of about a dozen different species, and found in all but one (doubtful) case a slight loss of weight in the saturated atmosphere of a thermostat.

(*To be continued.*)

UNUSUAL VARIATIONS OF TWO COMMON AGARICS.

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To say that *Armillaria mellea* is variable in its appearance is to fall far short of adequately expressing the truth in regard to this common agaric. Like *Laccaria laccata*, it puts on such an extremely unfamiliar look at times that one almost loses faith in the fixity of specific limits. Although typical forms are rarely wanting in its fruiting season, others are always abundant which, in color, surface, size, proportions, and especially in the character of the veil, are more or less striking in the tendency which they show to efface more or less completely some normally essential characteristic. Perhaps the taste is as constant as anything about the plant, and it may often be relied on to resolve a doubt. On the veil and ring no dependence can be placed whatever. Typically strong and fibrous, and even forming a wide-spreading, persistent collar, the veil is sometimes almost or entirely wanting at maturity. In a form found in Cambridge in October, 1898, and shown to the writer, the veil was glutinous and transparent, except immediately about the stem. The fibrous nature of the outer portions could not be detected by the naked eye any more than in the veils of *Cortinarius collinitus* or of *Hygrophorus fuligineus*. The glutinous character of the veil extended to the surface of the pileus which was extremely viscid. The plants were collected after a rain.

From several stations near Boston came reports last autumn of a form of the common *Lepiota naucina*, to which the name of "Smooth Agaric" has been given, in which the pileus was covered with brown scales. In two cases specimens were submitted which showed this character very strikingly, the surface being almost as rough and on the whole darker than is the case in *Lepiota cristata* and similar species. These forms were growing with others in every way typical. Such an

¹ Bot. Centrbl. LXXX., 1899, p. 333.